AG Contract No. KR96 0969TRN
ADOT ECS File No. JPA 96-52
Project: F-044-1-520/H4303 01X
Section: SR-260 MP 346 Drainage

INTERGOVERNMENTAL AGREEMENT
BETWEEN
THE STATE OF ARIZONA
AND
NAVAJO COUNTY, ARIZONA

THIS AGREEMENT is entered into 12 February, 1997, pursuant to Arizona Revised Statutes, Sections 11-951 through 11-954, as amended, between the STATE OF ARIZONA, acting by and through its DEPARTMENT OF TRANSPORTATION (the "State") and NAVAJO COUNTY, ARIZONA, acting by and through its Board of Supervisors (the "County").

I. RECITALS

1. The State is empowered by Arizona Revised Statutes Section 28-108 to enter into this agreement and has by resolution, a copy of which is attached hereto and made a part hereof, resolved to enter into this agreement and has delegated to the undersigned the authority to execute this agreement on behalf of the State.

2. The County is empowered by Arizona Revised Statutes Section 11-251 to enter into this agreement and has by resolution, a copy of which is attached hereto and made a part hereof, resolved to enter into this agreement and has authorized the undersigned to execute this agreement on behalf of the County.

3. The State and the County desire to participate in designing and constructing roadway drainage improvements on SR-260 at MP 346, at an estimated cost of $500,000.00, hereinafter referred to as the Project, for the safety and benefit of the motoring public. The parties agree that the County will be the lead agency for the Project.

THEREFORE, in consideration of the mutual agreements expressed herein, it is agreed as follows:

NO. 21359
FILED WITH SECRETARY OF STATE
Date Filed 02/12/97
Joan Hall
Secretary of State
By Vicky Greenwood

II. SCOPE

1. The County will:

a. Based on a study completed by CELLA BARR ASSOCIATES, dated December 11, 1995, which is attached hereto as Exhibit A and made a part hereof, provide to State standards design plans, specifications and such other documents and services required for construction bidding and construction. Incorporate State review comments. Obtain any necessary construction permits from the State.

b. Call for bids, and with the concurrence of the State, award one or more construction contracts for the Project. Administer same and make all payments to the contractor(s). Obtain the concurrence of the State on any Project related construction contract modifications. Be responsible for any contractor claims for extra compensation due to delays or whatever reason attributable to the County.

c. Be responsible for all costs associated with the Project over and above the State contribution of $250,000.00. No more often than monthly, invoice the State for the reasonable direct actual cost of design and construction of the Project, with no profit or fee, in a total amount not to exceed $250,000.00.

d. Insure completion of the entire Project generally in accordance with Exhibit A. Upon completion of the Project and with the concurrence of the State, approve and accept the Project as complete and provide maintenance to the Project outside of the State's right-of-way.

2. The State will:

a. Review the design documents and provide comments. Issue any required permits to the County or it's contractor(s).

b. Be responsible for any contractor claims for extra compensation due to delays or whatever reason attributable to the State.

c. Reimburse the County for the reasonable direct actual cost of design and construction of the Project within thirty (30) days after receipt and approval of invoices, in a total amount not to exceed $250,000.00.

d. Upon completion and acceptance of the Project by the County, provide maintenance to the Project inside the State's right-of-way.

III. MISCELLANEOUS PROVISIONS

1. This agreement shall remain in force and effect until completion of said Project and reimbursements; provided, however, that this agreement, except any provisions herein for maintenance and electrical energy, which shall be perpetual, may be cancelled at any time prior to the award of a construction contract, upon thirty (30) days written notice to the other party.

3. This agreement shall become effective upon filing with the Secretary of State. This agreement may be cancelled in accordance with Arizona Revised Statutes Section 38-511.

4. The provisions of Arizona Revised Statutes Section 35-214 are applicable to this contract.

5. In the event of any controversy which may arise out of this agreement, the parties hereto agree to abide by required arbitration as is set forth in Arizona Revised Statutes Section 12-1518.

6. All notices or demands upon any party to this agreement shall be in writing and shall be delivered in person or sent by mail addressed as follows:

Arizona Department of Transportation
Joint Project Administration
205 South 17 Avenue, Mail Drop 616E
Phoenix, AZ 85007

Navajo County
County Engineer
Box 668
Holbrook, AZ 86025

7. Attached hereto and incorporated herein is the written determination of each party's legal counsel that the parties are authorized under the laws of this state to enter into this agreement and that the agreement is in proper form.

IN WITNESS WHEREOF, the parties have executed this agreement the day and year first above written.

NAVAJO COUNTY, ARIZONA

By Jesse Thompson
~~PERCY DEAL,~~ Chairman
Board of Supervisors

Jesse Thompson

STATE OF ARIZONA
Department of Transportation

By Peter A. ENO
PETER A. ENO
Contract Administrator

ATTEST

By Judy Jones
JUDY JONES
Clerk of the Board

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16may

JPA 96-52

RESOLUTION

BE IT RESOLVED on this 16th day of May 1996, that I, the undersigned LARRY S. BONINE, as Director of the Arizona Department of Transportation, have determined that it is in the best interests of the State of Arizona that the Department of Transportation, acting by and through the Highways Division, to enter into an agreement with with Navajo County for the purpose of defining responsibilities for the design, construction and maintenance of drainage improvements on SR-260 at MP 346 (Wagon Wheel).

Therefore, authorization is hereby granted to draft said agreement which, upon completion, shall be submitted to the Contract Administrator for approval and execution.

Dalli D. Layton

for LARRY S. BONINE
Director

NAVAJO COUNTY BOARD OF SUPERVISORS

Governmental Complex - NC #18
P.O. Box 668 - 100 E. Carter Drive
Holbrook, AZ 86025
PHONE (520) 524-4053 FAX (520) 524-4239

EDWARD J. KOURY
County Manager

JUDY JONES
Clerk of the Board

RESOLUTION NO. 05-97

A Resolution of the Navajo County Board of Supervisors Acting in Their Capacity as the Navajo County Flood Control District Board of Directors in Support of an Intergovernmental Agreement With the Arizona Department of Transportation for the Purpose of Completing Drainage Improvements Along State Highway 260 Near Webb Lane

WHEREAS, the Navajo County Flood Control District has completed the Wagon Wheel Master Drainage Study with the goal of identifying, quantifying and developing solutions to flooding and drainage problems in the study area, and

WHEREAS, the Navajo County Board of Supervisors acting in their capacity as the Navajo County Flood Control District Board of Directors has adopted the Wagon Wheel Master Drainage Study results, and

WHEREAS, this master drainage study has identified the intersection of State Highway 260 and Webb Lane as an area with drainage and flooding problems and in need of drainage improvements, and

WHEREAS, the Arizona State Department of Transportation has agreed to fund up to $250,000 towards drainage improvements in the State Highway 260 - Webb Lane area; now

THEREFORE, BE IT RESOLVED that the Navajo County Flood Control District is committed to completing these improvements, and has therefore entered into the attached Intergovernmental Agreement with the Arizona Department of Transportation.

PASSED AND ADOPTED this 13th day of January, 1997.

Jesse Thompson

Jesse Thompson, Chairman
Navajo County Board of Supervisors

Attest: Judy Jones

Judy Jones, Clerk of the Board

JPA 96-52

APPROVAL OF THE NAVAJO COUNTY ATTORNEY

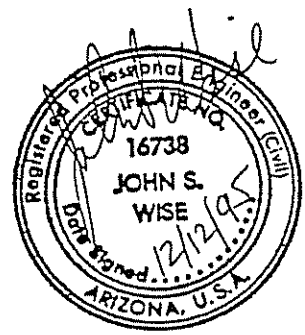
I have reviewed the above referenced proposed intergovernmental agreement, between the DEPARTMENT OF TRANSPORTATION, HIGHWAYS DIVISION, and NAVAJO COUNTY and declare this agreement to be in proper form and within the powers and authority granted to the County under the laws of the State of Arizona.

DATED this 8th day of January, 1997 ~~1996~~.

Bradley W. Carlyon
County Attorney, Deputy

WAGON WHEEL DRAINAGE IMPROVEMENT ALTERNATIVES AND FLOODPLAIN DELINEATIONS

Prepared for
Navajo County
Public Works Department



December 11, 1995
CBA File No. 107091-01-0282
KAD00150.02R

CELLA BARR ASSOCIATES
4911 East Broadway Boulevard
Tucson, Arizona 85711

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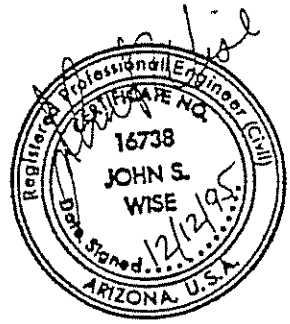
APPENDICES

Wagon Wheel Eighteen-Sheet Plan Set - Separate Package



I. EXECUTIVE SUMMARY

This report is to summarize work performed for a master drainage study for Section 9, Township 9 North, Range 22 East, within Navajo County. The study consists primarily of drainage improvement alternatives for specific drainage problem areas and floodplain delineations along the two prominent watercourses within the section. Cella Barr Associates (CBA) was retained by the Navajo County Department of Public Works to perform the study. JE Fuller/Hydrology & Geomorphology, Inc. provided hydrologic services for the project (refer to JE Fuller Wagon Wheel Master Drainage Plan - Hydrology Report, 1995).

The alternatives discussed within this report and illustrated on the associated plans are conceptual in nature. Design was based on Navajo County supplied 1-foot contour mapping and supplemental survey data. The floodplain delineations were developed to provide the Navajo County Flood Control District with a local floodplain management tool.

Based on available Flood Control District funding, design options such as storm sewer, concrete channels and other typical urban stormwater management structural improvements were not considered. The majority of the proposed alternatives consist primarily of earthen channels and corrugated metal pipes (CMP).

The solutions proposed in this study are conceptual in nature. Drainage problems in Wagon Wheel Park/Homestead Development could be relieved primarily through roadway improvements. The Scotts Pine Meadows areas will likely require improved channels along with roadway improvements. Finally, the ponding problems west of SR 260 could be mitigated to some degree by upstream detention or increased flow conveyance under SR 260. A holistic approach to any drainage improvements is recommended to ensure that isolated drainage problems are not solved that will create new drainage problems elsewhere.

II. INTRODUCTION

Several drainage problems exist in Navajo County within Section 9, Township 9 North, Range 22 East. The area of interest lies between Show Low and Pinetop-Lakeside adjacent to the Mogollon Rim. Please refer to Plan Sheets 1 and 2 of 18 for the site location and project map, respectively. A large portion of Section 9 is within a natural meadow environment and has gently sloping terrain.

Although the project drainage areas are less than a few square miles, significant drainage problems result from intense rainfall events and/or snowmelt. Dramatic lot and street flooding has been observed within the Wagon Wheel Park and Scotts Pine Meadows subdivisions by County staff and local residents. These subdivisions were developed prior to the existence of any drainage or floodplain ordinances; therefore, they have no drainage easements of significance and inadequate culverts at road and driveway crossings. Other drainage problems of concern at the intersection of Bear Run Road and Wagon Wheel Lane with Highway 260 result from a combination of disrupted natural drainage patterns and possible excessive runoff from Highway 260.

The enclosed information provides drainage-related calculations, estimates, analyses and designs for estimated flooding events up to and including the 100-year frequency flood based on specific engineering methodologies, ordinances, regulations, policies, etc. in effect and applicable at this time. A flood event of a magnitude exceeding the 100-year event as currently defined may cause or create the risk of greater flood damage than is or can be anticipated or presented in this assessment. Requirements of our contract did not include flood events greater than the 100-year event for evaluation. CBA assumes no responsibility for actual flood damage, increased risks of flood damage, or increased construction or development cost resulting from or related to any such events.

III. PROJECT DESCRIPTION

The project consisted of four main activities: a hydrologic study; culvert ratings of all Highway 260 crossings within the watershed; drainage improvement alternatives; and, floodplain delineations within Section 9. The hydrology and Highway 260 ratings were performed by JE Fuller Hydrology & Geomorphology, Inc. and are detailed in a separate report. The design flow rates used for the project are in the hydrology summary in Appendix A.

Drainage improvement alternatives were developed for areas within Scotts Pine Meadows subdivision, Wagon Wheel Park and the Homestead Development. In addition, channel design alternatives and culvert improvements were considered between Wagon Wheel Lane and Webb Drive. The design parameters for the alternatives considered are generally as follows: two alternatives for the 2-year event, two alternatives for the 10-year event and one alternative for the 50-year event.

The floodplain delineations were determined for two unnamed watercourses. For the purposes of this report, the wash that drains the southern part of the watershed and flows along the eastern edge of Scotts Pine Meadows subdivision will be called Scotts Pine Wash. The wash that drains the western and northern part of the watershed with its head waters near Wagon Wheel Park will be called Wagon Wheel Wash. Wagon Wheel Wash also has two minor tributaries that were modelled, referred to as tributaries 'X' and 'Y'. Both of these washes are mostly ephemeral and combine upstream of Show Low Lake Road before outletting into Show Low Creek. The floodplain delineations are based on the existing condition 100-year peak flow rate.

IV. DRAINAGE IMPROVEMENT ALTERNATIVES

A. Scotts Pine Meadows Subdivision

1. Overview

Scotts Pine Meadows subdivision consists of two units comprised of approximately 220 lots averaging 0.3 acre in size. The two major areas of frequent flooding are the intersections of Scotts Drive with Forest View Road, and the Scotts Pine Wash crossing of Pine Dawn Road. Other minor flooding occurs near the intersection of Scotts Drive with Pine Dawn Road and along unpaved roads in the northern portion of the subdivision. Most of the flooding problems are aggravated by inadequate driveway culverts and associated rigid driveway structures.

Several utility easements exist throughout the subdivision that could be considered for construction of drainage improvement solutions. However, most of the easements running north-south that could offer preferred flow paths currently have sanitary sewer lines. One available drainage easement exists on the western portion of the subdivision running north-south into an unnamed lake, referred to as "Tract A," on County plat maps. Unfortunately, drainage facilities placed within this easement would not alleviate drainage problems in the southern portion of the subdivision due to elevation constraints. The drainage problem area near Scotts Drive and Forest View Road is 13 feet lower in elevation than the upstream end of the aforementioned easement.

The lake in the northern half of the subdivision is currently dry. It appears that the lake is manmade and not a functional surface drainage feature for the area, and was likely filled with pumped ground water. The lake is surrounded by berms and appears to have a bottom near existing adjacent ground elevations. Significant excavation and regrading of much of the existing berm and lake bottom would be required for the lake to function as

a surface water detention facility. If the western portion of Tract A were developed into a detention pond, it could assist with mitigating 50-year flooding near Bear Run Road.

Existing right-of-way for County roads within the subdivision is typically 50 feet. Therefore, numerous improvements could be constructed to convey high frequency events through the subdivision. This would entail improving most of the existing driveway culverts. Throughout the subdivision, homeowners have placed concrete or brickwork around driveway culverts within County right-of-way. To provide significant drainage improvements along the existing roadways, homeowner education regarding the hydraulic impact of these structures must be a priority.

Any significant solution for the 50-year event will require some drainage easement acquisition and/or roadway reconfiguration. Utility conflicts could also become a significant design factor for 50-year flow rate solutions. Specific roadway crossings during a 50-year event would have to be modified as dip sections in order for the overall improvements to remain economically feasible. Refer to Plan Sheets 5 and 6 regarding the following discussions.

2. Scotts Drive and Forest View Road Area

The intersection of Scotts Drive and Forest View Road receives flows from the west from Forest Service land (see Plan Sheet 6). In addition, larger flows enter the subdivision from the south near Sherwood Drive. The design flow rates used for the drainage from the west for the 2-, 10- and 50-year events are 16, 47 and 69 cfs, respectively. The design flow rates for drainage from the south for the 2-, 10- and 50-year events are 24, 107 and 212 cfs, respectively. These flow rates were then combined and routed north for alternatives FV1, FV2 and FV50. Alternative FV1 proposes a channel along the west side of Sherwood Drive, while alternative FV2 proposes a

channel along the east side of Sherwood Drive. Alternative FV50 follows the same alignment as FV2. The channel and culvert dimensions mentioned are not always the same along the entire length of the specific improvement alternative.

The 2-year event along Sherwood Drive requires a trapezoidal channel with a depth of 1.5 feet and a top width of 12 feet. The bottom width and depth increase to 6 feet and 3 feet respectively at culvert crossings. Three 24-inch CMPs are required at road and driveway crossings to convey the 2-year event. The 10-year event requires a trapezoidal channel with a depth of 1.8 feet and a top width of 23 feet. The bottom width and depth increase to 17 feet and 3 feet respectively at culvert crossings. Four 36-inch CMPs are required at road and driveway crossings. The 50-year event requires a trapezoidal channel with a depth of 2.4 feet and a top width of 29 feet. The bottom width and depth increase to 23 feet and 4 feet at the Pine Dawn Road crossing. A dip section and the relocation of two driveways are proposed. The single culvert crossing at Pine Dawn Road would consist of five 42-inch CMPs.

Two-year improvements could be accomplished in the existing 50-foot right-of-way. The proposed 2-year alternatives would require a 100-foot-long, 15-foot-wide easement north of Pine Dawn Road. Ten-year improvements would require easements throughout the flowpath route. In addition, alternatives FV2 and FV50 are proposed along an existing sanitary sewer alignment for 750 feet. Coordination and approval from the sanitary district would be required.

Another improvement alternative that would help alleviate flooding at Scotts Drive and Forest View Road is to direct flows along Knottingham Lane to the north. These flows currently turn south at the intersection of Scotts Drive. The 2-, 10- and 50-year flow rates considered were 22, 41 and 51 cfs, respectively. The 2- and 10-year channel alternative (KL) has top

widths from 9 feet to 14 feet, respectively, and could be placed within existing right-of-way. The 50-year alternative (KL50) would require 16-foot top width trapezoidal channel. Channel transitions would be required at culvert crossings. The channel is proposed to outlet into a portion of the "TRACT A" Lake.

3. Scotts Drive and Pine Dawn Road Area

Drainage problems have occurred near and north of the intersection of Scotts Drive and Pine Dawn Road. No significant drainage system exists to relieve lot flooding on the north side of Pine Dawn Road. The existing flow rates for the 2- and 10-year events are 20 and 40 cfs, respectively.

Two alternative flow paths were considered (see Plan Sheet 6). Alternative PD1 follows the north side of Pine Dawn Road and would include driveway culvert improvements. Alternative PD2 proposes a channel along the north side of the Pine Dawn Road frontage lots within an existing easement. A trapezoidal channel with a top width of 10 feet will contain the 2-year flow rate, while a trapezoidal channel with approximately a 12-foot top width would be needed for the 10-year event. Channel transitions would be required at culvert crossings to increase the channel depths from 1 foot to 2 feet. Driveway culverts for alternative PD1 would be two 24-inch CMPs for the 2-year event and three 24-inch CMPs for the 10-year event.

4. Scotts Pine Wash Improvements

Scotts Pine Wash enters the southern portion of the subdivision from the southeast (see Plan Sheet 6). A defined channel exists up to the lots south of Pine Dawn Road. The road frequently overtops and results in flooding of nearby lots. Two existing 24-inch pipes cross the road, but have a poor outlet which limits the capacity. The existing flow rates for the 2-, 10-, 50-

and 100-year events at this location are 271, 613, 1,492 and 1,877 cfs, respectively.

Ideally, a dip section could be used to convey these flows. However, residents to the east use Pine Dawn Road as sole access to their property. Solutions were considered for the 2- and 10-year events. These solutions propose to relocate the existing flow path to the east. This would reduce needed easements for any significant improvements (see Plan Sheet 6) relative to following the existing flowpath. Trapezoidal channels with 2:1 side slopes were analyzed. The 2-year channel (Q_{DES} = 275 cfs) would have a depth of 2.5 feet and a top width of 28 feet, while the 10-year channel (Q_{DES} = 615 cfs) would have a depth of 3.5 feet and a top width of 36 feet. Channel transitions would be required at the Pine Dawn road crossing. Recommended culvert crossing structures consist of five 42-inch CMPs for the 2-year event and seven 48-inch CMPs for the 10-year event. The existing wash outlet could also be used.

Several lots would be affected by improvements to Scotts Pine Wash. Final design would need to ensure that the existing sanitary sewer is sufficiently protected. Purchase of parcels 212-09-125 C and 212-09-139, or significant easements, would greatly aid any long-term solution.

5. Bear Run Road

Parcel 212-09-115 A is located directly southeast of the intersection of Highway 260 with Bear Run Road (see Plan Sheet 5). The lot experiences frequent flooding due to runoff from the highway and lots to the south. There is no outlet for these flows as existing culverts are either crushed or full of sediment. The 2- and 10-year design flow rates are 5 and 10 cfs, respectively.

Both proposed alternatives route the water north across Bear Run Road. Alternative BR1 would travel north under Wagon Wheel Lane and Alternative BR2 would travel east along an existing easement. A triangular channel with a top width of 6 feet will contain the 2-year flow rate, while a trapezoidal channel with approximately a 9-foot top width would be needed for the 10-year event. Culvert crossings require one 22-inch by 13-inch pipe arch culvert for the 2-year event and one 24-inch CMP for the 10-year event.

B. Wagon Wheel Park/Homestead Development

1. Overview

Wagon Wheel Park and the Homestead Development are located adjacent to each other in the southwest corner of Section 9. The areas total 40 to 50 acres with lots of approximately 0.10 acre in size. The lots are on a hill (slope ≈ 2%), with the general flow direction to the northeast. Small ditches along the existing cinder roadways are the extent of a defined drainage system. Flooding problems are typically lot flooding due to ponding as a result of no defined drainage system. All existing culverts are typically 12 to 18 inches in diameter and significantly full of sediment.

The Lakeside Irrigation Canal also acts to direct some high surface flows towards the area. The canal runs northwest just upslope of the Homestead Development. Flow paths are evident across Parcels 212-08-127 and 212-08-128 of the development. It is likely the canal redirects surface runoff, which then can overtop the system at the Wagon Wheel Road culvert crossing. However, the canal is estimated to increase peak flow rates only 5 to 10 cfs. Minor upgrades to the canal berms upstream of the Homestead Development could reduce nuisance flows from the canal.

The area lacks significant drainage easements. The roadway right-of-way limits are 50 feet in Wagon Wheel Park and 34 feet in the Homestead Development. The roadway system in the Homestead Development can be improved to relieve the drainage problems, while the geometrics of the roads in Wagon Wheel Park are such that drainage relief cannot be provided to the entire subdivision without new outlet drainage easements along the east side. Refer to Plan Sheet 3 regarding the following discussions.

2. Homestead Development

The Homestead Development receives minor flows from the south. Proposed drainage improvements consist mainly of improving the roadway ditches and culverts along West Street and East Street, alternatives H1 and H2, respectively (see Plan Sheet 3). Design flow rates used for the 2- and 10- year flow rates were 2 and 18 cfs, respectively. The 2-year event would require one 18-inch CMP or one 14-inch × 23-inch pipe arch while the 10-year event would require two 18-inch CMPs or two 14-inch × 23-inch pipe arches at road and driveway crossings. The 2-year alternative could be constructed within the right-of-way, while the 10-year alternative would require some easements if the east path between the Homestead Development and Wagon Wheel Park is selected. A triangular channel can be used for both the 2- and 10-year events with appropriate transitions at culvert crossings.

Improvements to the existing irrigation canal would reduce flows which enter the development from the canal. Increasing the culverts under Wagon Wheel Road to two 24-inch CMPs and providing a 2-foot-high berm on the east side of the canal are proposed. Coordination with the Forest Service and the Show Low Irrigation District would be needed to initiate these improvements.

3. Wagon Wheel Park

Wagon Wheel Park experiences significant ponding due to no defined drainage system. Improvements to the roadway drainage system are critical to relieving ponding (see Plan Sheet 3). Design flow rates used for the 2-, 10- and 50-year events are 8, 42 and 66 cfs, respectively. The 2-year event would require one 18-inch CMP or two 14-inch × 23-inch pipe arches while the 10-year event would require two 30-inch CMPs or two 14-inch × 38-inch pipe arches at road and driveway crossings. Drainage improvements to A, C and E streets are required in conjunction with any other selected alternatives. The western or eastern branch of Woodland Parkway are alternatives W1 and W2, respectively, and were considered for the 2- and 10-year events. It is also recommended that the drainage system outlet be located to the north, if easements can be acquired. The 2- and 10-year roadway improvements could be constructed with the existing right-of-way.

B, D and F Streets are loops which cannot drain back to the center of the park. Any drainage outlet for these improvements would require new easements. Without acquiring easements on the eastern half of the park, no significant drainage improvements can occur to relieve lot flooding along B, D and F Streets. A 6-foot-wide easement would be needed for the 2-year flow and a 12-foot-wide easement for the 10-year flow.

The 50-year alternative (W50) consists of converting the east branch of Woodland Parkway to a trapezoidal channel with a depth of 1.5 feet and a top width of 15 feet. The western branch of Woodland Parkway would need to be improved to a two-way street. The northern portion of the loops on B, D and F Streets would become closed with three 30-inch CMPs or three 24-inch × 38-inch pipe arches at the southern channel crossings. Channel transitions would be required at culvert crossings. The 50-year channel and roadway improvements could both be contained within the existing 50-foot right-of-way. A 15-foot-wide outlet easement would also be required at the northern outlet.

C. Northern Wagon Wheel

1. Overview

Wagon Wheel Wash travels north through the area between Wagon Wheel Lane and Webb Drive. The existing culverts on Wagon Wheel Lane at the wash are located 550 feet west of Highway 260. These culverts cannot convey the 10-year event without overtopping the roadway. A high percentage of large flow rates do not pass through the culverts at all, and travel east towards Highway 260. Channel alternatives were also considered throughout Parcels 212-07-42b, 42c and 212-07-16 as part of this project.

A review was conducted of available aerial photography to help evaluate historic flow paths, which indicates flow to the north and northeast. This study focussed on existing flow paths, rather than historic flow paths. Development in the area and road improvements have likely focused the tendency for water to flow eastward prior to reaching Webb Drive, although some portions of flow are still conveyed northward via culverts under Wagon Wheel Lane. Significant ponding exists west of SR 260 and north of Wagon Wheel Lane, which may be a result of commercial and road development.

A HEC-2 model was developed to determine the flow rate splits at Wagon Wheel Lane. A significant percentage of the flow travels east towards SR 260 through the existing drive-in without reaching the existing culverts on Wagon Wheel Lane. The split flows are as follows:

DISCHARGE SPLIT AT WAGON WHEEL LANE			
Frequency	Total Flow Rate cfs	Split North cfs	Split East cfs
2-year	133	41	92
10-year	293	91	202
50-year	571	177	394
100-year	646	200	446

Refer to Plan Sheet 4 regarding the following discussion.

2. Wagon Wheel Lane - Wash Crossing

The existing culvert crossing consists of two 36-inch CMPs. Per the split flow analysis previously noted, these culverts are capable of passing the 2-year event (41 cfs) without overtopping the roadway. To pass the 10-year event (91 cfs), an additional 36-inch CMP is needed. To pass the 50-year event (177 cfs), an additional four 36-inch CMPs are needed. The existing culverts are to remain in conjunction with all proposed improvements.

3. Channel Alternatives

Proposed development north of Wagon Wheel Lane necessitated a conceptual channel design across Parcels 212-07-42b, 42c and 212-07-016. The design flow rates account for the previously mentioned flow rate analysis and an increase in flows near Webb Drive.

Trapezoidal, earthen channels were used in the design using 2:1 side slopes for the 2-, 10- and 50-year flow rates. The 2-year channel has approximately a 13- to 14-foot top width along the north-south alignment and increases to 22 feet at Webb Drive. The 10-year channel has approximately a 16- to 18-foot top width along the north-south alignment and increases to 30 feet at Webb Drive. The 50-year channel has

approximately a 25-foot top width along the north-south alignment and increases to 40 feet at Webb Drive.

Easements through the subject parcels will be needed for the channel construction. The proposed channel along the south side of Webb Drive is outside the existing right-of-way and would also need a temporary or permanent easement for construction.

4. Upstream Detention

Many of the drainage problems along Wagon Wheel Lane and SR 260 could be relieved with upstream detention to reduce peak flow rates. The existing wastewater ponds north of Wagon Wheel Park appear vacated and could be modified to serve as detention ponds. Detailed volume calculations or routings were not performed as part of this project. A conceptual schematic of the referenced possible detention basin location is depicted on Plan Sheet 2.

D. Highway 260

1. Overview

Highway 260 is a four-lane Arizona Department of Transportation (ADOT) road running north-south through Section 9. Many commercial properties align the highway. The highway was constructed to its present condition in the mid 1980s. The roadway centerline elevation is generally 2 to 4 feet higher than the natural ground and has a few minor culvert crossings. The highway is known to overtop at Wagon Wheel Lane during major events.

Refer to Plan Sheet 4 regarding the following discussions.

2. Wagon Wheel Lane

Water that splits from the main flow path, south of Wagon Wheel Lane, crosses the drive-in and concentrates at and near the intersection of Wagon Wheel Lane with SR 260. Flows could be relieved at this location by an improved channel along the west side of SR 260 and associated culvert improvements to Wagon Wheel Lane. The culvert improvements needed at Wagon Wheel Lane for the 2-year event are three 36-inch CMPs while the 10-year event requires five 42-inch CMPs. The 50-year flow would require two 8-foot × 4-foot box culverts along with associated major roadway improvements.

3. Webb Drive

The existing culvert crossing under SR 260 at Webb Drive consists of three 30-inch CMPs. These culverts are incapable of passing the 2-year flow rate without ponding occurring on adjacent lots. The proposed improvements assume that the split flow upstream of Wagon Wheel Lane rejoins at this location (no new culverts across SR 260 of Wagon Wheel Lane).

The proposed solutions were based on keeping the culverts' head water elevation below the adjacent lot. The 2-year event (208 cfs) would require three 36-inch CMPs in addition to the existing 30-inch culverts. The 10-year event (480 cfs) would require two 10-foot × 4-foot concrete box culverts. The 50-year event (930 cfs) would require four 10-foot × 4-foot concrete box culverts. Both the 10- and 50-year proposed solutions would require the removal and replacement of the existing culverts, in conjunction with ADOT coordination.

4. West Side Highway Channel

Wagon Wheel Wash crosses the highway in three 30-inch culverts at the Webb Drive intersection. Flooding occurs frequently to the lot just southwest of the crossing. The design flow rates account for split flow near the drive-in theatre and a local watershed to the south. The flow rates considered were 115, 243 and 448 cfs for the 2-year, 10-year and 50-year events, respectively.

In order for channel improvements along the west side of Highway 260 from Wagon Wheel Lane to Webb Drive to be effective, business access improvements would also be required. Four business accesses would need to be replaced with any channel improvements. Three-foot channel depths were used as a design control to prevent lot flooding and provide at least a 0.5 percent slope for the system. In addition, a 6:1 (horizontal to vertical) ditch slope is required along primary ADOT roads. The 2-year event requires a triangular channel with a top width of 21 feet, flared at culvert crossings. The 10-year event requires a trapezoidal channel with a 4-foot bottom width and a 28-foot top width. The 50-year event would require a trapezoidal channel with a 14-foot bottom width and a 38-foot top width.

The business access improvements consist of three 36-inch CMPs per crossing for the 2-year event and five 42-inch CMPs per crossing for the 10-year event. An alternate access (similiar to a frontage road concept) is recommended for a 50-year design so that a single channel crossing at Wagon Wheel Lane could be used. The 50-year culverts needed at Wagon Wheel Lane would consist of two 8-foot × 4-foot box culverts.

V. FLOODPLAIN DELINEATIONS

A. Scope of Study

Existing condition 100-year floodplain limits were determined for Scotts Pine Wash and Wagon Wheel Wash within Section 9. Two tributaries (referred to as X and Y) to Wagon Wheel Wash were also modelled. The study is intended to be used for local floodplain management purposes, and provide guidelines for new development.

B. Methodology

The 100-year floodplain limits for the above-referenced watercourses have been determined utilizing the U.S. Army Corps of Engineers HEC-2 computer model. Scotts Pine Wash is modeled as the main channel, and Wagon Wheel Wash was included and modeled as the tributary. The project limits extend approximately 1,000 feet downstream of the confluence of Scotts Pine Wash and Wagon Wheel Wash to Show Low Lake Road. The upstream limits for Wagon Wheel Wash are located approximately one-half mile west and 700 feet south of the intersection of Wagon Wheel Lane and Highway 260. The upstream project limit for Scotts Pine Wash is Forest View Road.

The cross-sections used in the HEC-2 model for each of the washes were coded using Navajo County supplied topographic aerial mapping of the watershed. The contour interval of the above-referenced topography is 1 foot, while the scale utilized varied depending on the required site detail. The cross-sections were generally spaced less than 500 feet apart, with areas requiring special attention coded at closer intervals. Each of the cross-sections were aligned such that they lie perpendicular to the direction of flow for the 100-year event. Sections were coded looking downstream while proceeding numerically from the most downstream point of the study reach to the upstream limit.

The HEC-2 model includes a starting water surface elevation based on the elevation of Show Low Lake Road. The model was developed as a subcritical model. Therefore, cross-sections proceed from downstream to upstream. The roughness coefficients used throughout the model are based on the existing ground cover in and around the channel areas obtained during site reconnaissance and from the aerial photos. The Manning's "n" value used for pasture/meadow areas is 0.035, and for overbank areas with trees an "n" value of 0.040 was used. The 100-year peak discharges used in the model were obtained from a separate HEC-1 analysis performed by JE Fuller/Hydrology and Geomorphology, Inc.

Culverts located at the upstream limit of Scotts Pine Wash and at Pine Dawn Road were not analyzed due to their limited capacity. These structures do not contribute significantly during the 100-year event.

C. Wagon Wheel Wash

Wagon Wheel Wash has been modeled as a tributary to the main channel, Scotts Pine Wash. The Wagon Wheel watershed delivers runoff from the west to SR 260 and Wagon Wheel Lane. A low-flow watercourse constructed upgrade of the drive-in facility at Wagon Wheel Lane drains the existing low lying area immediately west of the drive-in. This flow line delivers nuisance type flow to two 36-inch CMPs crossing at Wagon Wheel Lane (immediately north of the abandoned wastewater storage pond). The channel has very limited capacity (about 50 cfs) when compared to the larger, less frequent runoff events. During more extreme events (2-year return and greater), runoff breaches the channel to the east traversing the drive-in parcel and concentrates at the culverts at Wagon Wheel Lane and at the intersection of Wagon Wheel Lane and SR 260.

The drive-in area of Wagon Wheel Wash (Cross-Sections 6100 - 6350) was initially modeled using the HEC-2 split flow routine. The portion of flow which splits east concentrating at SR 260 proceeds north adjacent to SR 260, returning to the Wagon Wheel channel at the intersection of SR 260 and Webb Drive (Section 5600).

The existing cross-drainage culvert (three 30-inch CMPs) at Wagon Wheel Wash and SR 260 is severely undersized in comparison to extreme runoff events (Q_{50}, Q_{100}). The elevated roadway alignment obstructs flow resulting in a headwater pond at elevations of about 6590.4 (see Plan Sheet 17). These results were consistent for both the HEC-1 and HEC-2 models.

In addition, two minor tributaries to Wagon Wheel Wash were modelled to complete mapping in Section 9. Tributary "X" refers to the small watercourse running along the south side of Webb Drive. This tributary joins Wagon Wheel Wash upstream of the SR 260 culvert crossing. Tributary "Y" refers to the small watercourse running north along the east side of Wagon Wheel Park. This tributary joins Wagon Wheel Wash upstream of Wagon Wheel Lane.

D. Results

Floodplain limits have been determined for Scotts Pine Wash and Wagon Wheel Wash throughout the study section. The results account for split flow at Wagon Wheel Lane and ponding at the SR 260 culverts. Proposed improvements (as presented herein) to these areas would reduce the delineated floodplain. The floodplain downstream of SR 260 may be impacted, depending on upstream improvements. For example, if ponding were reduced upstream of SR 260 by increasing culvert capacity, increased flow rates would result, corresponding to increased flows and potentially wider floodplain limits downstream of SR 260. These effects have not been modelled in this study. The floodplain delineations are shown on Plan Sheets 7 and 8. Cross-sections showing the 100-year water surface elevations are on Plan Sheets 9 through 16. Profiles of the 100-year water surface elevations are on Plan Sheets 17 and 18. The HEC-2 output is contained in Appendix B.

VI. COST ESTIMATES

Cost estimates were prepared for the various alternatives. The unit costs used were based on locally supplied quotes and Arizona Department of Transportation 1994 Construction Costs. The cost estimates are for construction only, and do not account for contingencies (utility modifications, easements, rights-of-way, etc.) or design fees, but include estimates for major items such as culverts and earthwork. Detailed cost estimates are outlined in Appendix D. A summary table is presented below.

REGIONAL AREA	LOCATION	ALT.	COST		
			2-YEAR	10-YEAR	50-YEAR
Scotts Pine – Meadows	Scotts Drive and Forest View Road Intersection	FV1 FV2 FV50	$49,300 $40,290 –	$111,150 $95,290 –	– – $115,520
	Knottingham Lane	KL1 KL50	$37,600 –	$62,710 –	– $140,060
	Scotts Drive and Pine Dawn Road	PD1 PD2	$11,370 $18,060	$5,320 $9,120	– –
	Scotts Pine Wash	SP1	$187,200	$339,480	–
	Bear Run Road	BR1 BR2	$13,800 $11,940	$29,880 $31,390	– –
Wagon Wheel South	Homestead Development	H1 H2	$22,980 $13,060	$53,560 $30,870	– –
	Wagon Wheel Park	W1 W2 W50	$82,240 $82,240 –	$225,700 $225,700 –	– – $271,870
Wagon Wheel North	Wagon Wheel Wash Channel	CHL1	$37,400	$146,540	$258,930
	SR 260 Westside Channel	SCRHL1	$106,030	$150,310	$216,300

VII. CONCLUSION

Several significant drainage problems exist within the project areas. Mitigation of these problems will occur only through the cooperation of various agencies, entities and land owners. The main problem areas are Wagon Wheel Park/Homestead Development, Scotts Pine Meadows subdivision and along the west side of Highway 260.

- The drainage problems in Wagon Wheel Park/Homestead Development could be alleviated through improved road ditches and culverts, improvements to the upstream irrigation canal and outlet channels to the east and north. Any construction activities proposed for the Homestead Development road improvement district should include drainage improvements.

- Scotts Pine Meadows subdivision has more challenging issues due mainly to the flatter ground slope in problem areas. Road ditch and culvert improvements would alleviate a portion of the minor drainage problems. To provide relief for the 10-year event or greater, channels with minimum top widths of 12 feet are recommended. Existing road right-of-way is 50 feet, which could be helpful in reconstructing roadway sections to allow for improvements within existing right-of-way. The flow rates on Scotts Pine Wash are large enough that increased easement widths would be needed to provide a dry-weather crossing for the 10-year event.

- The ponding that exists along Highway 260 between Wagon Wheel Lane and Webb Drive could be mitigated through improved culvert crossing(s) on Highway 260 and/or upstream detention at the existing ponds north of Wagon Wheel Park. The Arizona Department of Transportation may be involved in evaluating mitigation measures to resolve ponding problems in this area.

All of the alternatives shown on the project plans are conceptual in nature. Detailed construction plans need to be developed showing plan and profile of channel/ditch alignments for any selected alternatives or variation thereof.

Public input for any proposed improvements will be critical to their success. The acquisition of easements for flood control purposes will require land owner support for the improvement. Cost constraints need to be identified to landowners so that they are aware of the financial challenge facing the District to solve specific drainage problems.

Future development in the project area should be regulated, incorporating the floodplain mapping. Homebuilders should plan to avoid the 100-year floodplain, or take appropriate protective measures if developing within those limits.

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INTERGOVERNMENTAL AGREEMENT DETERMINATION

A.G. Contract No. KR96-0969TRN, an agreement between public agencies, has been reviewed pursuant to A.R.S. § 11-952, as amended, by the undersigned Assistant Attorney General who has determined that it is in the proper form and is within the powers and authority granted to the State of Arizona.

No opinion is expressed as to the authority of the remaining parties, other than the State or its agencies, to enter into said agreement.

DATED February 10, 1997.

GRANT WOODS
Attorney General

JAMES R. REDPATH
Assistant Attorney General
Transportation Section

JRR:et/3569